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Effect of Location, Season, and Variety on Yield and Quality of Forage Oat

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ABSTRACT : Forage oat (*Avena sativa* L.) is grown extensively in a double-cropping system on dairy farms. Four oat varieties ('Swan', 'Targa', 'Foothill', and 'Nugene') were evaluated for forage production and forage quality during two growing seasons (spring and autumn) at two locations (central and southern region) in South Korea. The heading stage of four oat varieties was observed during spring, but the autumn season did not produce heading until harvest time except for the 'Swan' variety (early-maturing variety). The heading stage of 'Swan' in both locations was earlier compared to other varieties. The four varieties were resistant to both foliar disease and insects. Lodging resistance was higher during autumn except in 2002 at the central region, and late-maturing varieties ('Foothill' and 'Nugene') have lower lodging resistance. Dry matter (DM) content was significantly different between varieties ($p<0.001$). Comparing different varieties, 'Swan', an early-maturing variety, was highest in DM content. In DM, total digestible nutrients (TDN) and crude protein (CP) yield, the yield of oat varieties in the southern region was higher than in the central region, and forage yield of the oat varieties in the spring season was higher than during the autumn season. The DM and TDN yield showed significant differences between oat varieties. The CP content of oats grown in the central region (Cheonan) was lower than oats grown in the southern region (Daegu), and the spring season produced oats with lower CP compared to the autumn season. Among the four oat varieties, the CP content of late-maturing varieties was higher than the Swan variety (early-maturing variety). The acid detergent fiber (ADF) and neutral detergent fiber (NDF) contents were higher for the varieties grown in Cheonan and during the spring season. The ADF and NDF contents of late-maturing varieties were lower than the early-maturing variety. TDN and relative feed value (RFV) were higher for the varieties grown in Daegu and during the autumn season. Late-maturing variety had higher TDN and RFV than early-maturing variety. Our study showed differences in forage production and forage quality of oats grown in different locations, seasons and varieties. Forage quality as well as forage production was better in the southern region than in the central region. Forage quality was better during autumn, but forage production was better during spring. Late-maturing variety had better forage quality than the early-maturing variety. Therefore, late-maturing varieties are more suitable for use in the southern region. (**Key Words :** Double-cropping System, Early-maturing, Late-maturing, Selection of Variety)

INTRODUCTION

Oat (*Avena sativa* L.) is used extensively as feed for livestock because of its high-quality as well as its high-forage yield. In Korea, oat is grown primarily for fresh forage and silage, but occasionally also for hay or pasture. In 2003, approximately 300 tons of forage oat seeds were imported to Korea. Oat is cultivated in spring and autumn in a double-cropping system (Han, 1995; Kim et al., 1996; 1999; Lee and Kim, 1999).

Oat varieties can be categorized by the growth habit of the vegetative plants. Oat varieties with tillers that remain relatively flat or close to the ground during early growth are referred to as having a prostrate growth habit. These varieties tend to require more time and temperature to grow before harvest. Oat varieties with more upright tillers during their early growth are referred to as having an erect growth habit. As a group, these varieties have fast initial growth and wider but fewer tillers (Kipps, 1970; Poehlman, 1987; Stuart et al., 2002).

Oat may be classified according to the time of planting, either spring or autumn. Seven-tenths of the oat is fall-sown, and it is one of the most important forages being grown in Korea. The same variety is sown either in the fall or in the spring (Kim et al., 1999; Lee and Kim, 1999).

Late-maturing varieties do not produce any heading in

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Table 1. Planting date, harvest date and seeding rate of oat, and fertilizer rate at two locations, Cheonan and Daegu from 2002 to 2003

Location	Growing season	Planting date	Harvest date	Seeding rate (kg ha^{-1})	Fertilizer(kg ha^{-1})		
					N	P_2O_5	K_2O
	---------- 2002 ----------						
Cheonan	Spring	23 March	3 June	200	150	100	100
	Autumn	2 Sept.	6 Nov.	200	150	100	100
Daegu	Spring	16 March	31 May	200	150	100	100
	Autumn	5 Sept.	29 Oct.	200	150	100	100
	---------- 2003 ----------						
Cheonan	Spring	21 March	2 June	200	150	100	100
	Autumn	4 Sept.	11 Nov.	200	150	100	100
Daegu	Spring	25 March	6 June	200	150	100	100
	Autumn	20 Sept.	22 Nov.	200	150	100	100

autumn, but only during spring, which makes late-maturing varieties more suitable for spring. In Korea, early-maturing variety of oat produce heading in both spring and autumn season (Kim et al., 1996; 1999; Lee and Kim, 1999).

Oat continues to be an important forage because of their high yield potential and very good feed quality. Under favorable conditions oat can provide quality forage from late autumn to mid spring (Kim et al., 1996; Stuart et al., 2002).

The forage production and forage quality of oats are determined by numerous interacting factors, namely, environment, management practices, and genetics (Brundage et al., 1979; Jung and Allen, 1995; Elizalde et al., 1999; Firdous and Gilani 2001; Yu et al., 2004). Environmental factors such as temperature, precipitation, location, etc. strongly influence forage production and quality (Kim et al., 2001; 2005).

The performance of individual oat variety varies from region to region. This needs to be kept in mind if a variety is being chosen based on performance data from another region. When growing a new variety for the first time, it is advisable to only grow in a small area and check its local suitability (Yang et al., 1987; Kim et al., 1993; 1996; 1997; Stuart et al., 2002).

Commercial oat varieties have been selected primarily on the basis of forage yield and agronomic characteristics (Kim et al., 1993; 1996; 1997; Yang et al., 1987). However, the selection of forage oats has ignored potential variety differences in quality, and previous studies have identified variation in quality of oats (Kim et al., 1999). In Korea, forage quality has been tested mostly in the central region only.

Increased nutritional demand for optimal animal performance has challenged oat producers to select superior oat variety, and to combine good management practices to produce crop with high forage yield and favorable quality characteristics.

The objective of this experiment is to evaluate forage production and forage quality of different oat varieties in response to different locations and season.

MATERIALS AND METHODS

The experiment was conducted for 2 years (2002 and 2003) at two locations, Cheonan in the central region and Daegu in the southern region of South Korea. The soil in Cheonan is silt loam, while the soil in Daegu is sandy loam.

The experimental design was a randomized complete block in a split-split arrangement with three replications. Main plots consisted of two locations (the central region and the southern region), subplots consisted of two seasons (spring and autumn), and sub-subplots consisted of four varieties; 'Swan', 'Targa', 'Foothill', and 'Nugene'.

Seeds were hand-planted in each experimental plot (6 m^2 = 1.5×4 m). Fertilizer was applied at 150, 100 and 100 kg ha^{-1} of N, P and K, respectively (Table 1).

The planting dates at Cheonan were March 23, 2002 and March 21, 2003 for spring, September 2, 2002 and September 4, 2003 for autumn. The planting dates at Daegu were March 16, 2002 and March 25, 2003 for spring, September 5, 2002 and September 20, 2003 for autumn. The harvest dates at Cheonan were June 3, 2002 and June 2, 2003 for spring, November 6, 2002 and November 11, 2003 for autumn. The harvest dates at Daegu were May 31, 2002 and June 6, 2003 for spring, October 29, 2002 and November 22, 2003 for autumn (Table 1).

A sub-sample (800 to 1,000 g) was randomly selected from each harvested plot to estimate DM content and provide samples for forage quality analysis. The samples were weighed and dried for 72 h by forced-air drying oven at 65°C. The dried samples were reassembled and ground through a Wiley mill using a 1 mm screen.

Crude protein (CP) was determined by the Kjeldahl method (AOAC, 1990), acid detergent fiber (ADF) and neutral detergent fiber (NDF) were measured by the method of Goering and Van Soest (1970).

Values of total digestible nutrients (TDN) and relative feed value (RFV) were calculated from the following equation from Holland et al. (1990) from forage sample; TDN = 88.9-(0.79×ADF), and RFV = ((88.9-(ADF×0.779)×

Table 2. Mean air temperature and precipitation at two locations, Cheonan and Daegu from 2002 to 2003

Month	Temperature (°C)				Precipitation (mm)		
	2002	2003	30-yr average		2002	2003	30-yr average
	---------- Cheonan ----------						
Spring							
March	8.2	8.2	6.3		3.5	11.5	14.6
April	13.1	12.1	11.3		128.0	172.3	78.9
May	17.3	18.1	16.8		104.0	106.0	84.8
June	21.3	20.1	19.1		0.0	0.0	11.5
Mean	14.6	15.0	13.3	Sum	235.5	290.0	189.8
Autumn							
September	18.8	20.0	19.2		43.0	235.7	102.2
October	11.0	12.2	13.1		91.5	27.0	58.5
November	3.5	10.9	8.6		7.0	27.6	20.6
Mean	13.4	14.0	15.2	Sum	141.5	290.0	181.0
	---------- Daegu ----------						
Spring							
March	11.5	12.0	8.4		27.0	9.5	20.1
April	15.6	14.1	13.8		72.5	150.0	75.4
May	18.5	18.5	18.7		94.2	233.7	75.2
June	-	21.3	21.5		-	0.0	16.1
Mean	15.9	17.0	16.0	Sum	193.7	393.0	187.0
Autumn							
September	20.4	19.1	20.8		67.9	0.0	107.2
October	14.5	15.0	15.6		48.0	15.0	39.4
November	-	11.4	9.7		-	37.0	30.8
Mean	17.3	15.0	15.0	Sum	115.9	52.0	177.0

(120/NDF))/1.29.

Data were analyzed with analysis of variance (ANOVA) procedures using the SAS statistical software package (1999). The mean separation among treatment means for location, season and variety was obtained by using the Least Significant Difference (LSD) test (Steel and Torrie, 1980). Effects were considered in all statistical calculations for p-values <0.05.

RESULTS AND DISCUSSION

Mean temperature and precipitation during the growing season are presented in Table 2. The average temperature of the southern region (Daegu) was 1-3.9°C higher than the central region (Cheonan). However, the precipitation of the southern region was 26-238 mm less than the central region except in spring of 2003. Temperature patterns were similar between the first year (2002) and second growing year (2003), while precipitation differed markedly between the two growing seasons and years. Cumulative precipitation in autumn of 2002 was about 40-60 mm less than the normal yearly average. The drier than normal conditions at two locations occurred in September and November of 2002, however, the dry condition in 2003 was only experienced in Daegu during the autumn season. Consequently, oat was stressed by low water supply during the early and late growth stage.

The heading stage of four oat varieties was observed during the spring season, but the autumn season did not produce heading until harvest time except for the ‘Swan’ variety (Tables 3 and 4). The heading stage of ‘Swan’ in both locations was earlier compared to others. The heading stage of 'Swan' was observed during the middle of May, and that of the other varieties was observed towards the end of May.

This conclusion is consistent with the findings of Kim et al. (1996; 1997; 1999), who studied heading stages of different oat varieties. Late-maturing varieties do not produce any heading in autumn, but only during spring. Therefore, late-maturing varieties are more suitable for spring. Normally, early-maturing varieties of oat produce heading in both the spring and the autumn season in South Korea.

In general, the heading stage of an oat variety is delayed as it progresses in maturity, showing conclusively that heading stage affected yield and quality of forage oat, because the heading stage is strongly related to quality of oat (Kim and Kim, 1994; Kim et al., 1999; Lee and Kim, 1999; Ko et al., 2002), our results further confirmed that the heading stage of an oat variety is related to forage quality.

Early maturity is an important factor in the adaptation of varieties of oat in a double-cropping system in Korea,

Table 3. The agronomic characteristics of four oat varieties in 2002

Location	Season	Variety	HS	Resistance			Plant height (cm)	DM (%)
				Lodging	Disease	Insect		
Cheonan	Spring	Swan	17 May	9	8	9	106	24.9
		Targa	27 May	9	8	9	84	17.6
		Foothill	2 June	9	8	9	100	16.8
		Nugene	29 May	9	8	9	91	18.1
		Mean		9	8	9	92	19.4
	Autumn	Swan	-	9	8	9	77	14.7
		Targa	-	8	9	9	60	12.5
		Foothill	-	7	8	9	73	11.1
		Nugene	-	8	8	9	69	11.6
		Mean		8	8	9	70	12.5
	Mean			9	8	9	81	15.9
Daegu	Spring	Swan	14 May	8	9	9	106	26.0
		Targa	27 May	6	9	9	104	17.1
		Foothill	-	7	9	9	108	16.1
		Nugene	26 May	7	8	9	105	16.4
		Mean		7	9	9	106	18.9
	Autumn	Swan	-	9	9	9	76	15.4
		Targa	-	9	9	9	57	14.9
		Foothill	-	9	9	9	74	13.3
		Nugene	-	9	9	9	68	14.7
		Mean		9	9	9	69	14.6
	Mean			8	9	9	88	16.8

HD = Heading stage, Rating: 9 = Outstanding, 1 = Poor, DM = Dry matter.

Table 4. The agronomic characteristics of four oat varieties in 2003

Location	Season	Variety	HD	Resistance			Plant height (cm)	DM (%)
				Lodging	Disease	Insect		
Cheonan	Spring	Swan	16 May	9	9	9	111	21.0
		Targa	28 May	8	9	9	119	15.6
		Foothill	2 June	7	8	9	122	12.5
		Nugene	1 June	7	9	9	120	13.6
		Mean		8	9	9	118	15.7
	Autumn	Swan	27 Oct.	9	9	9	63	20.2
		Targa	-	9	9	9	42	19.6
		Foothill	-	9	9	9	73	15.3
		Nugene	-	9	9	9	71	16.2
		Mean		9	9	9	62	17.8
	Mean			9	9	9	104	16.7
Daegu	Spring	Swan	17 May	9	9	9	106	22.2
		Targa	1 June	8	9	9	112	15.5
		Foothill	4 June	7	9	9	117	15.3
		Nugene	31 May	6	9	9	111	16.4
		Mean		8	9	9	112	17.4
	Autumn	Swan	-	9	9	9	70	15.8
		Targa	-	9	9	9	47	15.6
		Foothill	-	9	9	9	60	13.9
		Nugene	-	9	9	9	57	15.1
		Mean		9	9	9	59	15.2
	Mean			9	9	9	86	16.3

HD = Heading stage, Rating: 9 = Outstanding, 1 = Poor, DM = Dry matter.

because early maturation would help the variety to escape damage from weather, leaf rust, or insects (Poehlman, 1987; Kim et al, 1996; 1997).

Differences in dry matter (DM) content were significant among location, growing season, and variety ($p<0.001$; Tables 3 and 4). Early-maturing oat ('Swan') was highest in DM content, and DM content was decreased as heading stage was delayed. Kim et al. (1996; 1997; 1999), and Lee

Table 5. Significance of main effects and their interactions in analysis of variance for forage yield and quality of oat in 2002

Source	df	DM	Yield			CP	ADF	NDF	TDN	RFV
			DM	TDN	CP					
Location (L)	1	**	***	***	***	**	***	**	***	***
Season (S)	1	***	***	***	***	***	***	***	***	***
Variety (V)	3	***	NS	NS	*	***	***	***	***	***
L×S	1	***	***	***	***	***	***	***	***	***
L×V	3	NS	NS	NS	NS	NS	**	*	*	**
S×V	3	***	NS	NS	NS	NS	**	***	**	***
L×S×V	3	NS	NS	NS	NS	NS	*	*	*	*
Error	32									
Total	47									

DM = Dry matter, TDN = Total digestible nutrients, CP = Crude protein, ADF = Acid detergent fiber, NDF = Neutral detergent fiber, RFV = Relative feed value.

*, **, *** Significant at the 0.05, 0.01, 0.001 probability levels, respectively.

NS = Not significant at the 0.05 level.

Table 6. Significance of main effects and their interactions in analysis of variance for forage yield and quality of oat in 2003

Source	df	DM	Yield			CP	ADF	NDF	TDN	RFV
			DM	TDN	CP					
Location (L)	1	NS	***	***	***	**	NS	NS	NS	**
Season (S)	1	NS	***	***	***	***	***	***	***	***
Variety (V)	3	***	NS	NS	NS	**	***	***	***	***
L×S	1	***	***	***	***	**	***	***	***	***
L×V	3	**	NS	NS	NS	NS	NS	NS	NS	**
S×V	3	***	**	**	*	**	***	***	***	***
L×S×V	3	NS	NS	NS	NS	NS	*	***	*	**
Error	32									
Total	47									

DM = Dry matter, TDN = Total digestible nutrients, CP = Crude protein, ADF = Acid detergent fiber, NDF = Neutral detergent fiber, RFV = Relative feed value.

*, **, *** Significant at the 0.05, 0.01, 0.001 probability levels, respectively.

NS = Not significant at the 0.05 level.

and Kim (1999) showed that heading stage of oat is related to DM content at harvest. The DM content of oat at harvest and heading stage were important factors to differentiate an early-maturing variety from a late-maturing variety.

The four varieties were resistant to both foliar disease and insect. Lodging resistance was higher during autumn except in 2002 at the central region (Cheonan). Late-maturing varieties have lower lodging resistance compared to early-maturing varieties (Tables 3 and 4).

Disease and insect resistance was given major attention in oat breeding during the past 40 years. However, because of farm mechanization in Korea, increased emphasis is given to lodging resistance recently as well as to early maturity of oat. Oat must stand in the field until harvested without lodging, to ensure that high yield is obtained.

Significant main effects (location, season, and variety) and their interactions were observed for most measured parameters (Tables 5 and 6). There were significant effects for location×season for all of the traits. Season×variety interactions was more often significant than location× variety interaction.

In DM, TDN and CP yield (Table 7), forage yield of the oat variety in the southern region was higher than in the central region, and forage yield of the oat variety during the spring season was higher than during the autumn season ($p<0.05$). This result was due primarily to air temperature rather than precipitation and other factors. Temperature in the southern region was higher than in the central region (Table 2).

The DM, TDN and CP yield have significant differences among oat varieties. The DM and TDN yield of the early-maturing variety (‘Swan’) was higher than late-maturing varieties (‘Targa’, ‘Foothill’ and ‘Nugene’) during the autumn season. However, the trend of oat variety was not seen on the DM and TDN yield of oat during spring season, and varieties which were higher in DM yield were also higher in TDN and CP yield.

The crude protein (CP) content of the oat varieties in the central region was lower than that of the southern region, and CP content of the oat variety at spring season was lower than during the autumn season ($p<0.05$). Among the oat varieties, CP content of late-maturing varieties was higher than the early-maturing variety (Table 8).

Oat does have limitations as a feed. It is low in crude

Table 7. Dry matter (DM), total digestible nutrients (TDN) and crude protein (CP) yield of four oat varieties at Cheonan and Daegu in 2002 and 2003

Location	Season	Variety	DM (kg/ha^{-1})		TDN (kg/ha^{-1})		CP (kg/ha^{-1})	
			2002	2003	2002	2003	2002	2003
Cheonan	Spring	Swan	2,674	8,901	1,561	4,953	310	1,002
		Targa	2,904	9,156	1,778	5,168	431	1,109
		Foothill	3,518	8,238	2,097	4,554	480	985
		Nugene	3,330	7,905	2,026	4,626	502	1,001
		Mean	3,106	8,550	1,866	4,825	431	1,024
	Autumn	Swan	3,619	1,415	2,333	1,008	588	229
		Targa	3,213	1,074	2,139	802	622	226
		Foothill	3,439	1,917	2,127	1,339	668	373
		Nugene	3,800	2,097	2,299	1,450	689	326
		Mean	3,518	1,626	2,225	1,150	642	288
	Mean		3,312	5,088	2,050	2,988	536	656
Daegu	Spring	Swan	11,366	8,865	6,699	5,358	1,276	1,035
		Targa	10,461	9,106	6,361	5,390	1,444	1,145
		Foothill	10,733	8,226	6,456	4,811	1,575	952
		Nugene	10,506	8,108	6,493	4,932	1,546	955
		Mean	10,767	8,576	6,502	5,123	1,460	1,022
	Autumn	Swan	3,155	4,116	2,187	2,805	566	801
		Targa	2,738	3,656	2,022	2,606	603	796
		Foothill	2,460	3,652	1,739	2,532	525	795
		Nugene	3,188	3,782	2,309	2,628	722	804
		Mean	2,885	3,801	2,064	2,643	604	799
	Mean		6,826	6,189	4,283	3,883	1,032	910
LSD (0.05)								
Location			415	275	281	182	89	61
Season			350	231	238	152	76	51
Variety			NS	NS	NS	NS	120	NS

protein and requires additional protein supplementation when fed to animals. Research indicates that most varieties of equal maturity do not differ significantly in protein content. If producers believe they are using varieties that are higher in protein, these varieties should be evaluated carefully to ensure energy concentration or total dry matter yield is not sacrificed.

The content of acid detergent fiber (ADF) and neutral detergent fiber (NDF) significantly differed with location, growing season, and variety (Tables 5 and 6). The contents of ADF and NDF of oat variety during the spring season were significantly higher compared to during the autumn season ($p<0.05$). Among the oat varieties, early-maturing oat variety was higher in ADF and NDF than late-maturing varieties during the spring season, however, the trend was not seen during the autumn season. This was reflected in the calculated values for TDN and relative feed value (RFV) (Table 9). We concluded that any prospective differences in chemical composition of the oat varieties and the relationships to forage quality of the varieties, probably would be best determined from ADF and NDF contents. This conclusion is consistent with the findings of Kim and Kim (1994) and Kim et al. (1999), who studied yields and chemical composition of oat varieties.

Treatment differences in TDN and RFV values (Table 6) were observed from different locations, growing season and variety ($p<0.05$). Late-maturing oats, specifically 'Targa' and 'Nugene', were higher in TDN and RFV values than the other oat varieties. Since TDN and RFV values were calculated from ADF and NDF, the observed differences were reflective of previously described ADF and NDF differences. Thus, a more comprehensive assessment on forage quality should be done for the different oat varieties in the different regions and at different seasons.

Effects on interaction between location and season was seen on forage production (DM, DM yield, TDN yield, and CP yield) ($p<0.001$) and forage quality (CP, ADF, NDF, TDN and RFV) ($p<0.001$, Tables 5 and 6). Forage production and forage quality was higher in the southern region than in the central region. In the southern region, forage production was higher during the spring season, while forage quality was better during the autumn season.

Effects on interaction between location and variety showed that in the southern region, late-maturing varieties have higher forage quality (ADF, NDF, TDN and RFV) ($p<0.05$, Tables 5 and 6). Effects on interaction between season and variety showed that late-maturing varieties have higher forage quality during both season ($p<0.01$, Tables 5 and 6). Interaction effects of the three factors (location, season and variety) showed that forage quality is better when late-maturing varieties are planted in the southern region during the autumn season ($p<0.05$, Tables 5 and 6).

In this study, various differences among the four oat

Table 8. Crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) of four oat varieties at Cheonan and Daegu in 2002 and 2003

Location	Season	Variety	CP (%)		ADF (%)		NDF (%)	
			2002	2003	2002	2003	2002	2003
Cheonan	Spring	Swan	11.6	11.2	38.6	42.3	62.6	69.3
		Targa	14.9	12.1	35.0	41.1	57.5	64.5
		Foothill	13.7	12.0	37.0	42.6	59.9	65.0
		Nugene	15.1	12.7	35.4	38.4	56.5	58.6
		Mean	13.8	12.0	36.5	41.1	59.1	64.4
	Autumn	Swan	16.2	16.4	30.9	22.1	49.1	43.4
		Targa	19.4	21.1	28.3	18.0	44.9	37.1
		Foothill	19.4	19.4	34.2	24.1	51.1	45.5
		Nugene	18.1	15.6	35.9	24.9	55.0	43.9
		Mean	18.3	18.1	32.3	22.3	50.0	42.5
	Mean		16.0	15.1	34.4	31.7	54.6	53.4
Daegu	Spring	Swan	11.2	11.7	38.5	36.5	64.5	61.4
		Targa	13.7	12.6	36.2	38.1	60.9	64.2
		Foothill	14.6	11.6	37.0	39.0	62.3	63.8
		Nugene	14.7	11.8	34.8	36.0	59.2	60.2
		Mean	13.6	11.9	36.6	37.4	61.7	62.4
	Autumn	Swan	17.9	19.4	25.2	26.7	46.9	49.2
		Targa	22.0	21.7	19.4	22.7	40.2	43.5
		Foothill	21.3	21.7	23.4	25.2	46.1	46.6
		Nugene	22.6	21.2	21.2	25.0	43.7	45.2
		Mean	21.0	21.0	22.3	24.9	44.2	46.1
	Mean		17.3	16.5	29.5	31.2	53.0	54.3
LSD (0.05)								
Location			0.6	0.8	1.0	NS	1.0	NS
Season			0.5	0.7	1.2	0.9	1.0	1.1
Variety			0.9	1.1	1.4	1.3	1.4	1.5

varieties were seen depending on location and growing season. The differences found were primarily in fiber composition (ADF and NDF) and CP content, which could possibly result in the differences in the digestible nutrient that would be available to the ruminants. While conventional thought says that a superior forage oat would have superior forage production, but data from this study suggest that the oat varieties with equal forage production do indeed have differences in forage quality.

Based on our study, the selection of variety may be even more important than high production so that the effects of low fiber composition and crude protein could improve animal productivity. Utilization of forage oats in the field should consider both forage quality and forage production.

In general, South Korea practices a double-cropping system and an early-maturing variety is used. However, the study showed that late-maturing varieties performed better in the southern region in both forage quality and production.

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Table 9. Total digestible nutrients (TDN) and relative feed value (RFV) of four oat varieties at Cheonan and Daegu in 2003

Location	Season	Variety	TDN (%)		RFV	
			2002	2003	2002	2003
Cheonan	Spring	Swan	58.4	55.5	87	75
		Targa	61.2	56.4	100	82
		Foothill	59.7	55.3	94	80
		Nugene	60.9	58.6	101	94
		Mean	60.1	56.4	96	83
	Autumn	Swan	64.5	71.4	123	154
		Targa	66.5	74.7	139	188
		Foothill	61.9	69.9	113	144
		Nugene	60.5	69.3	103	148
		Mean	63.4	71.3	119	158
	Mean		61.7	63.9	108	121
Daegu	Spring	Swan	58.9	60.5	85	92
		Targa	60.7	59.2	93	86
		Foothill	60.1	58.5	90	85
		Nugene	61.8	60.9	97	94
		Mean	60.4	59.8	91	89
	Autumn	Swan	69.3	68.1	137	129
		Targa	73.8	71.2	171	152
		Foothill	70.7	69.3	143	138
		Nugene	72.4	69.3	154	145
		Mean	71.5	69.5	151	141
	Mean		65.9	64.6	121	115
LSD (0.05)						
Location			0.8	0.8	2.6	3.0
Season			0.7	0.7	2.2	2.9
Variety			1.2	1.1	3.7	4.3

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